A Wave-length Comparator for Standards of Length.

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(Abstract.)

Two and a-half years ago the author was requested by the Standards Department of the Board of Trade to devise and superintend the construction of a new comparator, for comparing standards of length—the Imperial Standard Yard, for instance, with official or other copies—in terms of wave-lengths of light. The instrument now described is the result. Besides performing its functions as a wave-length comparator, and being the first instrument specifically constructed as such, it is also the most perfect instrument yet devised for measurement in wave-lengths in general. It is described to the Royal Society by permission of the President of the Board of Trade.

The principle of the instrument is that of the author's interferometer, described to the Society in 1898 in connection with an interference dilatometer, and again as improved in 1904 in connection with the author's elasmometer or interference elasticity apparatus. The interferometer, which is totally different from that of Michelson or that of Fabry and Perot, is adapted as regards details in a special manner for the specific object in view, but with the exception that a Hilger constant deviation prism is employed instead of a train of two spectroscope prisms, its principle is preserved intact.

The essential point of the instrument is that one of the two microscopes, employed to focus the two defining lines on a standard yard bar, actually carries just above the objective one of the two glass plates of the interference apparatus, which reflect the monochromatic light (hydrogen or cadmium red radiation) which is caused to interfere and produce rectilinear dark bands. When the microscope is moved the plate consequently moves with it, and the amount of movement is absolutely afforded by the movement of the interference bands, being equal to half the wave-length of the light employed for every band which passes the reference spot in the centre of the field of the interferometer telescope. So perfectly has this fine movement been achieved that the microscope and the bands can be caused to move simultaneously, by rotation of a large, fine-adjustment wheel, so steadily that each band can be made to pass the reference spot as slowly as one wishes

and be arrested instantly, without the slightest tremor, at any fraction of its width, so that the control of the bands and the counting is a perfectly simple matter.

In order to compare two standard bars, it is only necessary (1) to place the bar of known length, supported on an elaborate mechanism for the adjustment of the bars, under the two microscopes, carried on massive yet delicately-moving sliders on a 6-foot V-and-plane bed, so that the two defining lines are adjusted between the spider-lines of the micrometer eyepiece in each case; (2) to replace the standard by the copy to be tested, so that the defining line near one end is similarly adjusted under the corresponding microscope; then, if the other defining mark is not also automatically adjusted under the second microscope which carries the glass interference plate, as it should be if it is an exact copy, (3) to traverse that microscope until it is so adjusted, and (4) to observe and count the number of interference bands which move past the reference spot during the process. The difference between the bars is this number multiplied by the half-wave-length of the light in which the bands are produced.

The paper also gives an account of the electrical and thermal arrangements, as well as of the foundation masonry of the new comparator room. The temperature of the whole room is controlled entirely electrically, being maintained constant at the official temperature, 62° Fahr. The thermostatic arrangements are of an original character, and of two different independent types—a thermometric and a resistance type.